Ex 2 / Blatt 6

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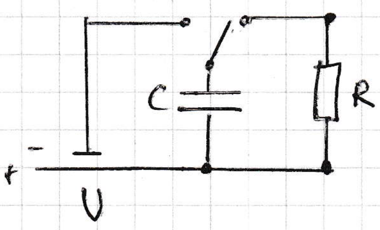


a) Kondensator: $Q = C \cdot U$

Widerstand: $U = R \cdot I$ $\Longrightarrow$ $Q = C \cdot R \cdot I$

$Q(t) = -C \cdot R \cdot \frac{dQ(t)}{dt}$ $\quad | \cdot \frac{d}{dt}$ $\quad$ (−) weil Ladung abnimmt

$\Longrightarrow \quad I(t) = -C \cdot R \, \frac{dI(t)}{dt}$

b) $I(t=0)$ … keine Ladung abgeflossen

$= \frac{U}{R} = 50\,mA = I_0$

Lösung $\quad I(t) = e^{-\frac{t}{RC}} \cdot I_0 \qquad \tau = R \cdot C = 0{,}2\,ms$

c) $Q(t) = \int I(t)\,dt + C \qquad C = 0$

$= \frac{RC\,I_0}{\cancel{RC}}\, e^{-\frac{t}{RC}}$

$\Delta Q = \frac{RC\,I_0}{\cancel{RC}} \left(1 - e^{-\frac{t}{RC}}\right) \overset{1\mu C}{=} 9{,}93 \cdot 10^{-6}\,As$

$Q_0 = C \cdot U = 10\,\mu C \qquad \approx 99{,}3\,\%$ von Q_0

d) Energie: $\frac{1}{2} C U^2$

Wärme: $W = \int_0^\infty P(t)\,dt = \int_0^\infty U(t) I(t)\,dt = R \int_0^\infty I(t)^2\,dt$

$= R \cdot I_0^2 \int_0^\infty e^{-\frac{2t}{RC}}\,dt = \frac{1}{2} R^2 C\, I_0^2 \underbrace{\left[e^{-\frac{2t}{RC}}\right]_0^\infty}_{=-1} \overset{U=R\cdot I}{=} -\frac{1}{2} C U^2$

$\boxed{21}$ a) $E_{kin} = q\cdot U = \frac{1}{2} m v^2$ $\qquad E_{kin} = 4\cdot 10^{-15}\,J = \underline{\underline{25\,keV}}$

$$\Rightarrow \quad v = \sqrt{\frac{2qU}{m}} = \underline{\underline{6,94\cdot 10^5\,\frac{m}{s}}}$$

$$F_L = q\cdot v\cdot B \qquad F_Z = \frac{mv^2}{r}$$

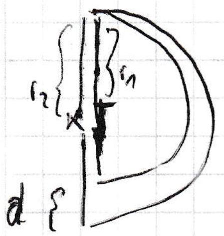
$$\Rightarrow \quad F_L \overset{!}{=} F_Z \qquad q\cdot \cancel{v}\cdot B = \frac{m v^{\cancel{2}}}{r} \quad \Rightarrow r = \frac{mv}{q\cdot B}$$

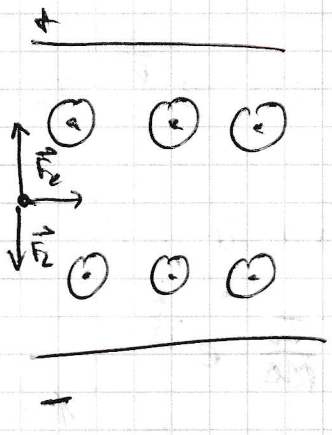
mit $v = \sqrt{\frac{2qU}{m}}$ $\quad \Rightarrow \quad r = \sqrt{\frac{2mU}{qB^2}} = \underline{\underline{4,8\,cm}}$

b) $d = 2(r_1 - r_2)$

$$d = 2\sqrt{\frac{2U}{qB^2}}\left(\sqrt{m_1} - \sqrt{m_2}\right) = 4,8\,mm$$

c)





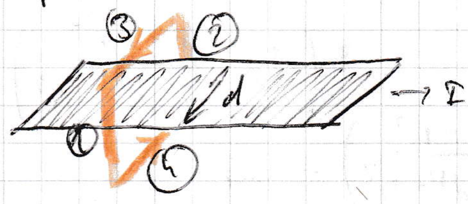
$F_{el} = F_L$

$Eq = qvB$

$E = v\cdot B$

$$E = \sqrt{\frac{2qU}{m}}\cdot B = \left(1,04\cdot 10^6\,\frac{V}{m}\right)$$

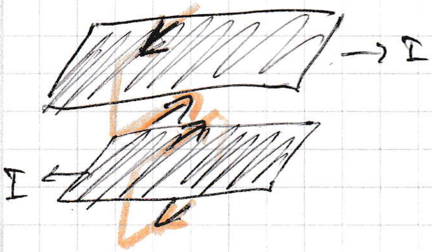
22 Ampere - Gesetz



$\oint \vec{B} d\vec{s} = \mu_0 I$

① + ② klein

$\oint \vec{B} d\vec{s} = 2 \cdot B \cdot d = \mu_0 I \Rightarrow B = \frac{\mu_0 I}{2d}$



zwischen zwei Platten

$B' = 2 \cdot B = \frac{\mu_0 I}{d}$

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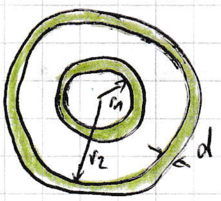

$\oint \vec{B} d\vec{s} = \mu_0 I$

$I(r) = \frac{j}{\cancel{A(r)}} \cdot A(r)$

$I = j \cdot \pi(r_1+d)^2 - \pi r_1^2$
$= j \cdot \pi(r_2+d)^2 - \pi r_2^2$

$r < r_1$: $I = 0 \Rightarrow B(r) = 0$

$r_1 < r < r_1+d$: $I(r) = j \cdot \pi r^2 - \pi r_1^2$

$\Rightarrow B = \frac{\mu_0 \cdot j \cdot \pi r^2 - \pi r_1^2}{2\pi r} = \frac{\mu_0 I}{2\pi r} \frac{r^2 - r_1^2)}{(r_1+d)^2 - r_1^2}$

$B(r) = \frac{\mu_0 I}{2\pi r} \frac{r^2 - r_1^2}{(r_1+d)^2 - r_1^2} \sim r$

$r_1+d < r < r_2$: $I(r) = I$

$\Rightarrow B(r) = \frac{\mu_0 I}{2\pi r} \sim \frac{1}{r}$

$r_2 < r < r_2 + d$: $I(r) = I - j\,A(r) = I - j\,\pi(r^2 - r_2^2)$

$$= I\left(1 - \frac{r^2 - r_2^2}{(r_2+d)^2 - r_2^2}\right)$$

$$\Rightarrow \quad B(r) = \frac{I\mu_0}{2\pi r}\left(1 - \frac{r^2 - r_2^2}{(r_2+d)^2 - r_2^2}\right) \sim -r$$

$r_2 + d < r$: $I(r) = 0 \quad \Rightarrow \quad B(r) = 0$